

ADDITIVES
for
PLASTICS
H a n d b o o k

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Plastic Handbook
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dispersion of mineral

Additives for Plastics Handbook

203

in PVC compositions,
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for high temperature
development);
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Neosiloxane resins;
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Chapter 14: Plasticisers

Short-cut information:

Plasticisers

Function	Added to make a compound more flexible, easier to process; mainly used with PVC; also for cellulose
Properties affected	Flexibility, viscosity
Materials/ characteristics	Monomeric: esters of phthalates, adipates, mellitates Polymerisable esters: di-phthalate ester
Disadvantages	Migration; strict compliance with food contact regulations
New develop- ments	Greater efficiency at lower addition levels, easier mixing; replacement of potentially hazardous types; reduction of leaching/migration

additives for Plastics Handbook

Additives for Plastics Handbook

209

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used in vinyl plastisols where
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lactone modulating effects. February

Chapter 15: Process modifiers and processing aids

Short-cut information:

Process modifiers and processing aids

Function	Improvement of processability of compounds: lubrication, higher output/lower energy Modification of polymer properties: nucleation for greater product homogeneity, clarifying agents for improved transparency
Properties affected	Productivity Product quality, transparency
Materials/characteristics	Fluoropolymers Sorbitol clarifying agents Elastomeric property modifiers, polybutene, acrylic Silicone modifiers MBS, acrylic impact modifiers Fatty acid dispersion aids
Disadvantages	No significant disadvantages known
New developments	Improvement in productivity, energy requirement for processing

Resin modifiers

Thermoplastics

Polystyrene as a modifier in polypropylene/ethylene-vinylene elastomer blends gives flexible components with good impact strength and processability. A recent study by Amoco¹ showed that at a level of about 50% of the elastomer content there is no loss of impact at 20°C, while flexural modulus values are 27,000-39,000 psi and melt flow is 80-100% higher than the unmodified blend's (contributing to better processability). Although polybutene reduces the tensile strength, heat distortion temperature and hardness of the blends, counterparts have a good balance of properties.

Potential applications include flexible automotive components such as air bag door covers and multi-guards, gasketing and wire jacketing and replacement of plasticized PVC in toys, sporting goods, tools and other consumer items.

Extrusion-grafted (maleated), animated polyolefin-based polymers (such as Exolon[®] from Exxon) are used as impact modifiers, compatibilizers and adhesion promoters, giving a valuable combination of properties for high-value applications.

- Impact modification of engineering thermoplastics
- Compatibilization of polymer blends in alloying and recycling
- Adhesion enhancement of polyolefins to metal, glass and polar substrates, by coextrusion, CTR and extrusion coating
- Polymeric matrix adhesion to reinforcing agents, such as glass fibre and inorganic fillers, and to flame retardants, such as magnesium hydroxide
- Adhesion of EPDM elastomers to polar substrates for rubber fuses and V belts, and of general purpose rubbers to carcass in tyre sidewall compounds is also improved, as is co-vulcanization of EPDM with polar rubbers

They offer low levels of residual ungrafted monomers, minimizing industrial hygiene problems and offer good colour with low level of contaminants and easy handling in compounding operations.

Elastomer modification

What is claimed to be an original technology for modification of nylon 6 with conventional acrylic rubber has been developed by EnChem Elastomers. Previously acrylic elastomers were used only in the rubber industry and conventional polymers (such as core-shell acrylic polymers) are based on the rubber in hard phases. EnChem's AR, however, is based on a soft phase only, which increases the specific

Additives for Plastics Handbook

rubber efficiency in the impact resistance characteristics, so differing from other traditional elastomers (BRT, SEBS) used in modification of nylon.

Extensive laboratory tests have shown that impact-resistance level is increased with only 17% EnChem AR and impact resistance characteristics are better than those obtained with 20-25% of other elastomers. Both the low level of rubber and elastomer characteristics of the soft phase acrylic increase the resistance to high temperature (Vicat $T_g = 170^\circ\text{C}$) and the flexural modulus of modified nylon. The high thermomechanical inertia and the polarity of these rubbers also allows post-treatment to the nylon which were not previously possible.

New technology to harness silicones

New technology aimed at utilising the properties of silicones more effectively in additives has been announced by Wacker Chemie GmbH. Silicones offer a combination of properties which makes them interesting as modifiers for plastics, improving impact resistance and giving resistance to change in temperature and weathering. But, because they are not compatible with organic polymers, it has often proved difficult to incorporate them into organic polymer systems. In particular, distribution and domain size of the silicone phase has been difficult to control.

Wacker has developed what it describes as 'core-shell particles': flexible silicone cores surrounded by an organopolysiloxane shell, with precisely defined particle sizes and very narrow particle-size distribution. The organic shell makes the particles highly compatible with other organic polymer systems, allowing selective adjustment of the silicone modified phase in the host polymer compound.

Properties which can be conferred by these additives include low temperature flexibility, resistance to changing temperatures and UV resistance. Undesirable effects, such as release and deposition of surface tension, which in the past have been caused by migration of the silicone, have not been observed.

Impact modifiers - PVC

Impact modifiers for PVC include methyl butadiene styrene (MBS) and acrylics.

MBS modifiers improve impact strength of PVC compounds without sacrificing the other characteristics. They are used for a variety of rigid and semi-rigid applications and processes, such as blow moulding of bottles, calendaring of film and sheet, extrusion of profile and injection moulding of technical parts. Some types can also be tailored to suit specific requirements.

Acrylic modifiers significantly improve impact characteristics of PVC without any effect of weatherability. The main applications are profile, pipes and sheets. Acrylic components are used in film reactor (traditionally the Gertman approach), but acrylic additives are gaining in popularity as an efficient alternative.